Spool And Spool Assembly For Winding-Up Carrier Tapes of Packaging Taped Imbricated Bag Chain

The present application is a 35 USC §371 application of PCT/EP2005/050147 filed January 14, 2005 which claims the benefit of European Patent Application No. 04075389.9 filed February 9, 2004.

Field of the invention

The present invention relates to the field of bag packaging and in particular to taped imbricated bags. More in particular, it relates to a spool, a spool assembly (which can be housed in a proper cassette), for winding up adhesive carrier tapes conveying a chain of imbricated bags.

Background of The Invention

It has been known for many years to package food products, for instance meat cuts or poultry, in proper bags. Generally, the packaging bags are conveyed to a loading station in an imbricated bag chain form. The bags are maintained in such an imbricated form and conveyed by using a pair of single side adhesive tapes. Generally, the tapes are wound on spools while the chain of bags is pulled towards the loading station.

GB 2 064 477 relates to a taped bag dispenser, namely an apparatus for dispensing bags from a chain of bags connected together in an imbricated arrangement on a pair of tapes. It is connected to a source of taped bags and to a device comprising a spool for winding each tape, drive means which transmits motion to a differential gear which imparts rotational movement to the spools whereby the spools can rotate at different speeds so as to maintain substantially equal tension in the two tapes and thus maintain the bags in an aligned state. A sensing means detects the presence or absence of a bag and is in operative communication with the drive means which may comprise a sprocket and chain or a pneumatic ram.

The dispenser according to GB 2 064 477 has the inconvenience that the differential gear is somewhat complex, expensive and is integral with the dispenser. Furthermore,

the step of replacing a wound spool is rather complicated and time consuming. This results in rather long stops of the whole apparatus dispensing bags.

US 4,796,412 relates to a method of packaging utilizing a taped bag chain with cassette.

A bag chain for feeding packaging bags to a bag loader includes bags imbricated and carried by a pair of parallel carrier tapes which are wound up on spools of a cassette. Loading the bag chain in a bag indexing drive unit involves simply placing the cassette into position with the spools engaged with parallel drive dogs, after which operation of a drive motor, driving the dogs through a differential unit indexes the bags and winds up the tapes. Upon complete consumption of the bag chain, the cassette can be removed and replaced by a fresh cassette with the tapes outside the cassette and carrying the imbricated bags.

While the loading and unloading steps of the cassette have become easier and more convenient than with the spools of GB 2 064 477, the drive unit is still complicated and the cassette is rather expensive.

PCT/EP03/10754 relates to an apparatus for taking up a succession of imbricated taped bags and a method of loading a bag train on a bag loader. The apparatus comprises two carrier tape winding spools positioned coaxially with one another and a differential gear unit positioned between said spools, said differential gear unit being adapted to be, in use, removably connectable to a shaft of a bag loader whereby two carrier tapes can be wound up on said spools with equal tension. In one embodiment, each of the spools have a recess in a surface which faces the other spool and the differential gear unit is positioned in said recesses.

The inventor has felt the need to provide an apparatus which is able to wind a longer length of tapes. Bags are presently packaged in a box or the like and it is desirable to have a larger number of bags within a box. A larger number of bags results in longer tapes to be wound. Having a higher number of bags without having to replace the cassette is a profitable feature because it avoids stops of the loader plant and makes the throughput higher.

A tape which is generally used for taped imbricated bags is made of polypropylene (while also polyesters or the like could also be used) and is about 6,0 mm wide and about 0,1 mm thin. One side of the tape is lined by an adhesive composition for sticking the bags. Presently, a tape is about 50 m long, this length corresponding to a number of bags of about 1500.

In one embodiment, a spool to be used in connection with PCT/EP03/10754 is made of a plastic material and comprises a cylinder core, a first plurality of spokes extending outwardly at a first end of the cylinder core and a second plurality of spokes extending outwardly at an opposed end of the core. The free ends of the first and second spokes are

connected by respective outer rings. In other words, the first and second spokes form a race where the adhesive tape is wound. In one embodiment, the spool is made of two pieces snapping on each other. The race is slightly wider than the tape.

The inventor has realized that when a first length of an adhesive tape is wound on a spool, the tape turns are placed one on each other in a regular and fundamentally tidy manner. When a longer length of tape is wound, the turns tend to move axially and the tape turn configuration becomes untidy and unstable. While further turns of tape are wound on the spool, the radial pressure on the wound turns becomes higher. As a consequence, the intermediate and outer turns operate a high radial pressure on the inner turns, the radial pressure becoming higher and higher while the number of turns increases. Such a high radial pressure, as the turns tend to move axially, pushes against the lateral surface (substantially defined by the spokes) of the race. This results in a deformation of the spool and, possibly, in a failure thereof.

With the above in mind, it is only possible to wind a rather reduced length of tape, corresponding to a rather reduced number of bags, without running the risk to have the spool blocked or broken.

In the inventors opinion, the problem of tape axial shifting during winding thereof is caused by several factors, including the narrowness of the tape causing instability as the Eulero's beam and the fact that a fluid is interposed between each single turn of tape. In fact, each tape has a side which is coated with a fluid adhesive substance providing a rather reduced adhesive force. This results in axial movements of the tape while it is winding up.

The inventor has studied such a problem in order to find a solution thereto. A possible manner to solve the problem could be having a stiffer and harder spool but this is not compliant with the main requirement to have a cheap and light weight spool.
The inventor has discovered that a further possible solution is to provide resilient means at the spool core for releasing a radial pressure acting on the turns of tape that have been firstly wound up when such a pressure has reached an excessive value. In this way, the first wound up turns of tape become subject to a reduced or substantially null radial pressure.

Summary of The Invention

In a first aspect of the present invention, a spool for winding up an adhesive carrier tape of a packaging taped imbricated bag chain in an apparatus for taking up a succession of imbricated packaging bags comprises a core with a core surface and walls forming a race where turns of tape are wound up, wherein the core surface comprises resilient

means for releasing a radial pressure acting on the turns of tape that have been wound up first.

In one embodiment, the resilient means comprise at least one resilient projecting tongue.

In one embodiment, a plurality of equally-spaced resilient projecting tongues are provided on the core surface.

In one embodiment, the tongues are fundamentally tangent to the core surface. In one embodiment, the tongues are inclined at an acute angle with respect to a tangent to the core surface.

In one embodiment, the thickness of the tongues decreases towards the free ends thereof.

In one embodiment, the tongues are moulded with the core surface or a part thereof.

In one embodiment, the spool is at least partially made of a plastic material or the like.

When the tongues are moulded with the core surface, the core surface In one embodiment comprises proper cavities at the base of each tongue.

In one embodiment, the tongues are at least partially made of metal or the like.

In one embodiment, said resilient means comprise a continuous liner of a resilient material.

In one embodiment, said resilient material comprises a rubber or a foamed plastic material. In one embodiment, said resilient material is a foam material, either an open-cell or a closed-cell material.

In one embodiment, said spool comprises two separate parts snapping one on each other for forming an assembled spool.

In one embodiment, each spool wall comprises two or more spokes radially extending outwardly from the core, the free ends of the spokes being connected by an outer ring.

In a second aspect of the present invention, a spool assembly for winding up at least two adhesive carrier tapes of a packaging taped imbricated bag chain in an apparatus for taking up a succession of imbricated packaging bags comprises at least two spools, each spool comprising a core with a core surface and walls forming a race where turns of tape are wound-up, wherein the core surface comprises resilient means for releasing a radial pressure acting on the turns of tape that have been wound up first.

In one embodiment, the assembly further comprises a differential gear unit positioned between said at least two spools, said differential gear unit being adapted to be, in

use, removably connectable to a shaft of a bag loader whereby two carrier tapes can be wound up on said spools with equal tension.

In one embodiment, each of said spools has a recess in a surface which faces the other spool; the differential gear unit is positioned in said recess.

In one embodiment, each of said at least two spools is integrally formed with a bevel gear coaxial with the spool.

In one embodiment, the differential gear unit comprises a core and at least one satellite pinion gear attached to said core and positioned to mesh with each bevel gear. In one embodiment, the differential gear unit core comprises a mating hole for mating with a shaft of a bag loader.

In one embodiment, the assembly is housed in a housing, thus providing a cassette or the like.

In a third aspect of the present invention, an apparatus for taking up a succession of imbricated packaging bags carried by at least two carrier tapes comprises at least two carrier tape winding spools positioned coaxially with one another; and a differential gear unit positioned between said spools, the differential gear unit being adapted to be, in use, removably connectable to a shaft of a bag loader whereby two carrier tapes can be wound up on said spools with equal tension, wherein the spools each comprise a core with a core surface and walls forming a race where turns of tape are wound-up, wherein the core surface comprises resilient means for releasing a radial pressure acting on the turns of tape that have been wound up first.

Brief Description of The Drawings

The present invention will become clearer from the following description, given by way of example only and not of limitation, with reference to the accompanying drawings, wherein:

Fig. 1a is a perspective view of a bag train with a spool assembly being loaded onto a bag loader;

Fig. 1b is a perspective view of a bag train with a cassette being loaded onto a bag loader;

Fig. 2 is an exploded view of the apparatus for taking up a succession of imbricated packaging bags of the present invention;

Fig. 3 is an exploded view of a spool assembly within a housing according to an embodiment of the present invention;

Fig. 4 shows a plan view of a first half spool according to the present invention;

Fig. 5 shows a cross section view taken along line 4-4 of Fig. 4;

Fig. 6 shows a plan view of a second half spool mating with the first half spool of Fig. 4;

Fig. 7 shows a cross section view taken along line 6-6 of Fig. 6;

Fig. 8 shows a cross section view of an assembled spool according to the invention;

Fig. 9 is a partial view of the first half spool of Fig. 4 under a low pressure;

Fig. 10 is a partial view similar to that of Fig. 9 under a higher pressure; and

Fig. 11 is an enlarged view similar to that of Fig. 9.

Detailed Description of The Invention

Figure 1a shows schematically how the present invention is employed in use on a bag loader machine 100. A bag train 50 comprises a plurality of packaging bags 51a, 51b, 51c arranged in an imbricated way on two parallel carrier tapes 52a, 52b, typically about ½ bag width apart. The bags 51a, 51b, 51c are attached to the tapes 52a, 52b by adhesive. The end of the tapes 52a, 52b are bound to spools of a spool assembly 10. The spool assembly 10 is loaded by hand, without tools, on to a shaft 112 of the bag loader 100 so that the unit is adapted to be, in use, removably connectable to the shaft. The adaptation may be by way of a snap-on fitting, a butterfly nut, an over center buckle etc. Any way of attaching the unit by hand, without the use of tools, so that little time or skill is required can be used. The shaft 112 is rotated by motor 110. The shaft 112 engages with the spool assembly 10 and drives the internal workings of the assembly to take up the tapes 52a, 52b. On taking up of the tapes 52a, 52b the succession of bags 51a, 51b, 51c are brought closer to the bag loader machine 100. As the tapes are taken up successive bags 51a, 51b, 51c can be removed from the tapes 52a, 52b and filled.

During drawing of the bags 51a, 51b, 51c towards the bag loader 100, it is necessary to keep the tension in the two tapes 52a, 52b equal so that the bag openings, usually directed in the direction of advancement, remain in the same orientation to the bag loader 100 (i.e. usually parallel to the bag loader) such that the bags may be removed from the tapes automatically. In the present invention this is done by use of the spool assembly 10 which ensures that the tapes 52a, 52b, as they are drawn in towards the bag loader around rollers or stationary pins 54a, 54b, are kept in equal tension. This is achieved by the internal workings of the assembly 10 which are illustrated in Figures 2 and 3.
The way in which the spool assembly 10 takes up the carrier tapes 52a, 52b with equal tension will now be described with reference to Figure 2 or 3. The spool assembly 10 comprises two carrier tape winding spools 12a, 12b around which the tapes 52a, 52b of the bag train 50 are to be wound. In one embodiment, as it is shown in Figures 1b and 2, the spools 12a, 12b are enclosed in a housing providing a cassette 140 comprising first

and second components 14a, 14b which can, for example, snap fit together. A slot 15 formed in the first housing component 14a allows entry of the tapes 52a, 52b into the housing and thereby onto spool 12a for one tape 52a and spool 12b for the other tape 52b. Two slots may be provided, one for entry of each tape 52a, 52b. If those slots are positioned as far apart as the tapes are apart when attached to the bags, no rollers or pins 54a, 54b are required. The tapes 52a, 52b are attached to the spools 12a, 12b in any convenient way, for example through a hole in the outer flange of the spool and held in place by a pin inserted in the hole from the outside. The tapes 52a, 52b are wound around the spools 12a, 12b in the same direction.

The spools 12a, 12b are positioned coaxially with one another. Each of the spools 12a, 12b is depicted as having a central cut out 13 though this is not necessarily required. In fact, only one of the spools 12a, 12b will require a central cut out 13 so that the shaft 112 of the bag loader can access a differential gear unit 20 positioned between and coaxially with the spools 12a, 12b. The shaft 112 passes in a cut out 16, through the central cut out 13 of spool 12b to mesh with a mating hole 22 in a core 21 of the differential gear unit 20. Thus, the spools 12a, 12b and core 21 of the differential gear unit are coaxial with the shaft 112 of the bag loader when the spool assembly is loaded on the bag loader. Mounted on the core 21 is at least one bevel pinion 24. In one embodiment there are four bevel pinions 24 positioned symmetrically around the outside of the core 21. The bevel pinions 24 are mounted to the core such that they can freely rotate around an axis perpendicular to the longitudinal axis of mating hole 22.

The differential gear unit 20 is held substantially coaxially with said spools 12a, 12b by being positioned in recesses in the surfaces of the spools facing each other so that the spools can be positioned close together, possibly even touching. The action of engaging the spool assembly with the shaft 112 may serve to axially align the spools 12a, 12b and the core 21 of the differential gear unit and to hold them together. Alternatively, the spools and differential gear unit may be designed to snap fit together (or otherwise held together) without the aid of the shaft 112 so that the shaft 112 only engages with the differential gear unit 20.

Each of the spools 12a, 12b is provided with an integrally moulded bevel gear 26 (in the recess) which, when the spool assembly 10 is assembled, faces the other of said spools 12a, 12b and meshes with the bevel pinions 24. In this way, if equal tension is present in the tapes 52a, 52b and the shaft 112 of the bag loader rotates the core 21, the two spools 12a, 12b will be rotated at the same rate as the bevel pinions 24 will not rotate around their axis of rotation but the whole core and spool assembly will rotate at the same rate around the longitudinal axis of the shaft 112. However, if tension in one of the tapes 52a, 52b decreases, the spool 12a, 12b on which that tape is wound will rotate faster than

the other spool. This happens because the bevel pinions 24 will begin to rotate until the tension in the tapes 52a, 52b wound around their respective spools 12a, 12b is equalised. In this way it is possible to maintain the bag train 50 in an orientation such that each successive imbricated bag 51a, 51b, 51c will arrive at the bag loader in the perfect orientation for removal from the tapes 52a, 52b as the tapes 52a, 52b are taken up by the spools 12a, 12b of the assembly 10.

According to one embodiment, the spool assembly 10 is housed in the cassette 140 (see Figures 1b and 2). Although a door to protect the cassette 140 is shown in Figure 1b, in practice this may not be necessary.

The cassette housing components 14a, 14b, spools 12a, 12b and the parts of the differential gear unit may all be formed by injection moulding of plastics material. This is inexpensive and the thus produced components easily have the durability to last for the entire bag train which can comprise several hundred bags.

It is envisaged that the spool assembly or the cassette will be stored, for example during shipping, with the leading part of each of the tapes connected to the respective spool so that the entire bag chain 50 may be loaded onto the loader easily without first having to connect the tapes 51a, 52b onto the spools 12a, 12b.

The spool assembly 10 or cassette 140 can be re-usable. In use, the machine operator would attach the next bag train to the spools of a spare cassette while the machine is still working using another bag train. Once that other bag train is finished, the operator can substitute the old cassette (or the spool assembly) for the spare one and restart the machine.

With reference now to Figures 4 to 8, a carrier tape winding spool 12 (12a or 12b) according to the present invention comprises a cylinder core 121 with a cylinder surface 122. Projecting radially outwardly from the edges of the core surface 122 are spokes 123 connected by an outer ring 124. The spokes and the outer ring form a wall 123'. The spokes could be replaced by a continuous surface resulting in a continuous wall 123'. The walls and the core surface, in turn, form a race 125 where turns of adhesive carrier tape 52 wind up. In one embodiment, the spool 12 comprises two separate parts 127, 128 snapping one on each other for forming an assembled spool. A first part 127 could be, for instance, a holed projecting core 121 with a wall 123'(possibly made of spokes 123 and a connecting ring 124) while the second part 128 (shown in Figures 6 and 7) could be substantially flat, again with spokes 123 and a connecting ring 124. In the embodiment shown in Figures 6 and 7, a number of hooks 130 project from the second spool part 128. When the spool is assembled by connecting the first and second parts 127, 128, the hooks 130 enter corresponding holes 130' of the first part 127.

According to the present invention, the core surface 122 is provided with resilient means 126 for releasing a radial pressure acting on the turns of tape that have been firstly wound-up. According to a first embodiment, the resilient means 126 is in the form of at least one resilient projecting tongue 126. In one embodiment, as in Fig. 4, a plurality of equally-spaced resilient projecting tongues 126 are provided on the core surface 122. According to an embodiment, the tongues 126 are substantially tangent to the spool surface. Alternatively, the tongues are inclined at an acute angle with respect to a tangent to the spool surface. The angle at which the tongues are inclined with respect to the tangent direction is about 5° to 30°, such as 10° to 20°, such as about 15°. Angles that are deemed suitable for the present invention include 5°, 10°, 14°, 15° and 20°.

According to one embodiment, the tongue thickness decreases towards the free end thereof. This feature is provided in order to reduce the increasing stiffness of the tongues that, when a pressure is exercised, tend to mate to the cylinder core surface and to correspondingly reduce their length.

In one embodiment, the tongues are moulded with the core surface 122 or a part thereof, in particular when the spool is at least partially made of a plastic material. When the tongues are moulded with the core surface 122, the core surface 122 in one embodiment comprises proper cavities 129 at the base of each tongue 126 (see Fig. 11). This facilitates the moulding of the tongues in a single piece with the core. According to the present invention, the tongues 126 could also be made of metal or the like.

While an array of equally spaced tongues 126 provides excellent results, good performance can be obtained by providing a continuous liner of a resilient material around the core surface. The liner could be made of a rubber or a foam, i.e. a material that can be compressed under pressure. The foam material can be "open-cell" or "closed-cell". Any type of polymeric material that can be foamed, thus resulting in a compressible foam, can be suitably employed, for instance, polyethylene, polyurethane, polyesters and the like. With reference to Figures 9 to 10, the operation of the tongues 126 will be described herein. When a rather reduced number of turns of tape 52 are wound around the core 121, the tongues 126 are subject to a rather reduced pressure and, substantially, they will not bend. While the number of wound turns increases, the radial pressure acting on the tongues 126 will increase accordingly and the tongues 126 become bent. In this manner, the radial pressure on the turns that are wound first will be compensated and the tape 52 will not move towards the race walls 123'. Because of this, the number of turns on the spools could be highly increased with respect to the known spools and the general object of the invention is reached.

Fig. 11 is similar to Fig. 10 but it shows the cavities 129 at the root of the tongues 126. Such cavities are useful for producing the tongues in a single piece with the core by a plastic injection moulding process.

The present invention has been described by way of example only and variations are possible. In particular, as described above, the cassette 140 is not necessary for the functioning of the invention as shown in Figures 1a and 2. The construction of the housing of the cassette could be varied.